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Two New Taxa and One New Report of *Tarenna* (Rubiaceae) for the Flora of Cambodia and Vietnam

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A new species, *Tarenna aurantiaca* Naiki & Tagane (Rubiaceae) from Hon Ba Nature Reserve, southern Vietnam, and a new variety *T. pilosa* var. *parvifolia* Naiki & Tagane from Bokor Nature Reserve, southern Cambodia, are described and illustrated. *Tarenna costata* (Miq.) Merr. is reported for the first time for the flora of Cambodia. A key to the species of *Tarenna* in Indochina, including Cambodia, Laos and Vietnam, is provided.

Key words: Bokor National Park, Cambodia, Hon Ba Nature Reserve, new species, new variety, Rubiaceae, *Tarenna*, Vietnam

Tarenna Gaertn. (Rubiaceae) is a genus of 203 species of shrubs and trees (Davis *et al*. 2009). The species are widely distributed in tropical Asia and Africa (De Block & Robbrecht 1998) and widely occur from low to high elevation (Kesonbua & Chantaranothai 2006). *Tarenna* has been classified in the tribe Pavetteae along with the genera *Dictyandra, Leptactina, Pavetta, Rutidea* and *Triflorensia* (Andreasen & Bremer 2000, Reynolds & Forster 2005), and is characterized by often 4-angled stems, 5-merous hermaphroditic flowers, and fruits crowned by the persistent calyx.

Recently, floristic studies of *Tarenna* in Thailand (Kesonbua & Chantaranothai 2006, 2008) reported 24 species, but no revisions of *Tarenna* are available for other areas in Indochina, although 8, 8 and 16 species have been reported from Cambodia, Laos and Vietnam, respectively (Pitard 1924, Dy Phon 2000, Hô 2000, Newman *et al*. 2007, Lanorsavanh & Chantaranothai 2011).

To advance our knowledge of *Tarenna* in those countries, we studied the taxonomy of *Tarenna*, based on our new collections from Cambodia and Vietnam (Fig. 1). Here, we report *Tarenna aurantiaca* Naiki & Tagane as a new species from Vietnam, *T. pilosa* var. *parvifolia* as a new variety from Cambodia and *T. costata* as a new distribution report for Cambodia. The new taxa and distribution report were based on consultation of the taxonomic literature (e.g. Pitard 1924, Kesonbua & Chantaranothai 2008), dried herbarium specimens at BKF, BM, K, P, VNM and digitized images of specimens on the web

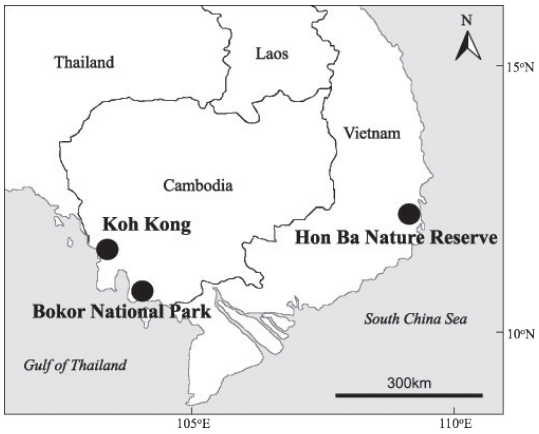

FIG. 1. Location of Bokor National Park, Koh Kong, Cambodia, and Hon Ba Nature Reserve, Vietnam.

(e.g. JSTOR Global Plants, http://plants.jstor.org/).

The specimens collected in Vietnam are deposited in the herbarium of the Museum of Kyushu University (FU), the herbarium of the Institute of Tropical Biology (VNM), the Hon Ba Nature Reserve station and partly in the herbarium of Kyoto University (KYO). Those from Cambodia are deposited in the herbarium of the Forest Administration of Cambodia (here abbreviated as Cam), FU and partly in KYO.

Taxonomic treatments and notes

Tarenna aurantiaca Naiki & Tagane, **sp. nov.** — Figs. 2A–G.

Similar to *Tarenna mollissima* (Walp.) Rob. in leaf shape and dense hairiness on twigs and leaves, but different in having orange flowers (vs. white flowers) and 9–11 mm long corolla tube (vs. tube 3–4 mm long in *T. mollissima*).

Typus. Vietnam. Khanh Hoa Province, Hon Ba Nature Reserve, in evergreen forest, alt. 617 m, 12°06′40″N, 108°58′59″E, 16 Jul. 2014, *S. Tagane, H. Kanemitsu & V. S. Dang V1681* [fl. & fr.] (holo–KYO!, iso–FU!, K, the Station of Hon Ba Nature Reserve!, VNM!).

Description. Shrubs, 3 m tall; young branchlets greenish or greyish brown, densely hairy with short spreading hairs, 4-angled; old branchlets greyish brown, hairy or glabrous, subterete. *Stipules* connate near base, triangular, triangular-ovate, ca. 4–5 × 3–6 mm, apex acute, finely hairy outside, glabrous inside. *Leaves* opposite; petiole 0.6–2.5 cm long, finely hairy; blade obovate, oblanceolate or narrowly elliptic, (5.2–)12.5–22.2 × (2.2–)3.4–7.1 cm, base cuneate, margins flat, apex acuminate, acumen up to 1.6 cm long, thinly chartaceous, drying greenish or greyish brown with whitish nerves, both surfaces pubescent with spreading hairs, especially dense on veins, scabrous, midrib slightly sunken on upper surface, raised on lower surface, lateral veins 9–16 pairs, ascending at an angle of 45–50° from midvein, impressed on upper surface, prominent on lower surface, tertiary veins scalariform-reticulate, indistinct on upper surface, faintly distinct and prominent on lower surface. *Inflorescences* terminal, compound corymbiform panicles, axis 3–5 branched, 3–6 × 5–10 cm, central first order axis 0.7–1.5 cm long, lateral first order axes 1.3–3.3 cm long, 8–74 flowered; bracts present at the base of branches, both foliar and stipular, narrowly elliptic, linear or narrowly triangular, to 1.5 cm long; pedicels 6–7 mm long, bracteoles 1(–3) on each pedicel, narrowly triangular-ovate, ca. 1.2 mm long, densely hairy. *Flowers* 5-merous, rarely 4-merous, pedicellate. *Calyx* densely hairy with whitish spreading hairs, tube 1.5–1.7 mm long, ca. 1.3 mm in diam., green when fresh, lobes (4 or)5, narrowly triangular, apex acute, (0.3–)1.0–1.2 × ca. 0.3 mm, orange, fused base of calyx lobes hairy inside; colleters usually 2 between lobes, narrowly ovoid, ca. 0.2 × 0.05 mm, orange. *Corolla* orange, tube cylindrical, widening slightly toward throat, 9–11 mm long, pubescent except near base, lobes tongue-shaped, ca. 7 × 2 mm, slightly reflexed, glabrous adaxially, appressed hairy abaxially, stamens (4 or)5, alternate corolla lobes, attached to throat; filaments 0.8–1.4 mm long, glabrous; anthers linear, ca. 5.5 mm long, yellow, glabrous. *Styles* exerted 14–17 mm beyond corolla throat, distal 7–9 mm glabrous, lower part silky hairy. *Ovary* 2-locular, villous with white hairs inside, disc slightly prominent; ovules ca. 20 in each locule. *Fruits* globose, 5–6 mm in diam., green when fresh, drying black, pubescent. *Seeds* 18–34 per fruit, angular, 1.5–2 × ca. 1.3 mm, blackish brown when dried.

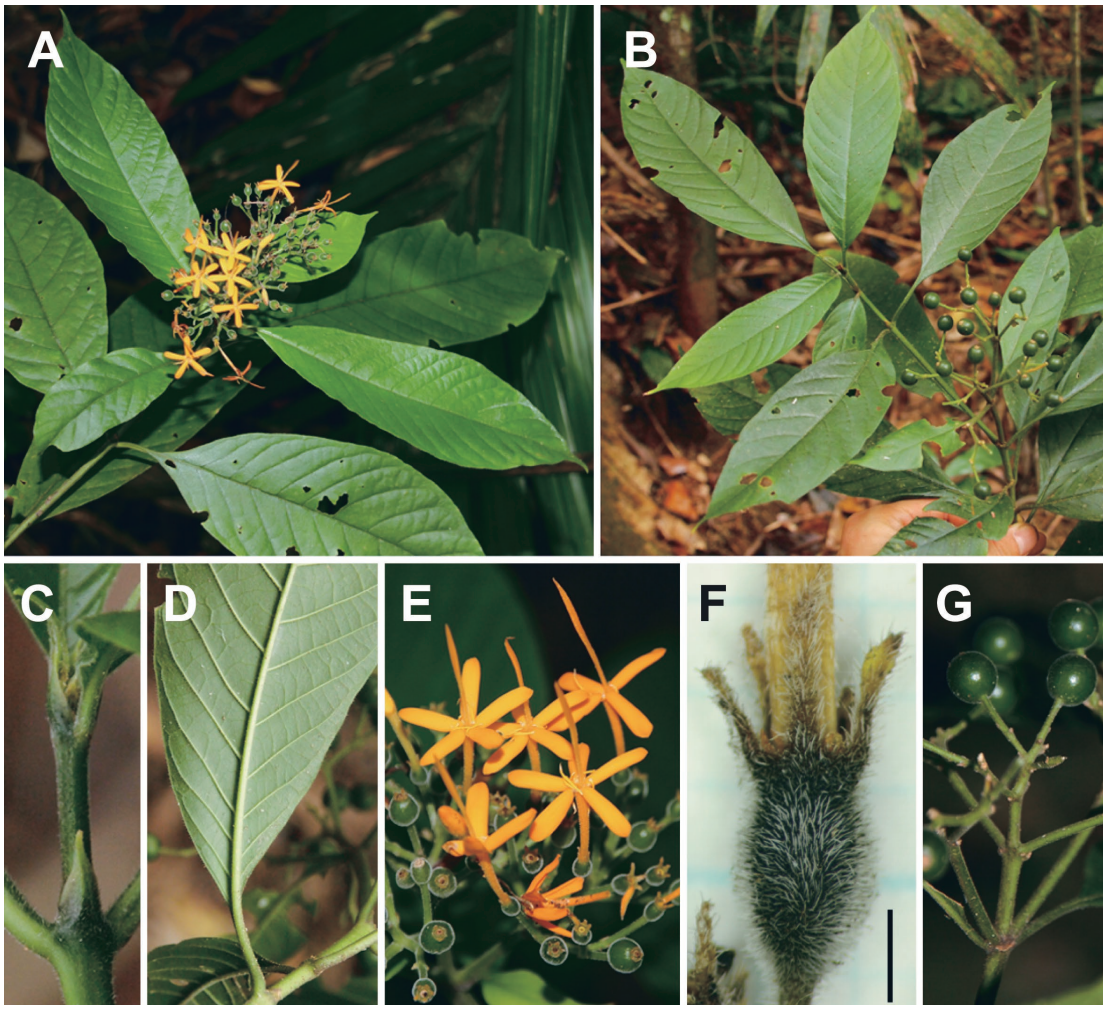

FIG. 2. *Tarenna aurantiaca* Naiki & Tagane, sp. nov. A. flowering branch; B. fruiting branch; C. terminal branch with stipules; D. abaxial leaf surface; E. flowers; F. ovary covered with calyx tube, scale bar = 1 mm; G. fruits. Specimens: A–G. *Tagane et al. V1681* (FU).

Additional specimens examined. Vietnam — **Khanh Hoa Province:** Mt. Hon Ba, alt. 890 m, 12°06′51″N, 108°58′23″E, 21 Jul. 2013, *S. Tagane, T. Yahara, H. Nagamasu, K. Fuse, H. Toyama & V. S. Dang V642* [fl.] (BKF, FU, the station of Hon Ba Nature Reserve, VNM); roadside, edge of evergreen forest, alt. 622 m, 12°06′40″N, 108°58′59″E, 19 Feb. 2014, *H. Toyama, V. S. Dang, S. Tagane, K. Fuse, H. Nagamasu & H. Tran V793* [fr.] (BKF, FU, the station of Hon Ba Nature Reserve, VNM); in slope of evergreen forest, alt. 617 m, 12°06′40″N, 108°58′59″E, 23 Feb. 2014, *H. Toyama, V. S. Dang, S. Tagane, K. Fuse, H. Nagamasu & H. Tran V1254* [fr.] (FU, KYO, the station of Hon Ba Nature Reserve, VNM); in evergreen forest, alt. 617 m, 12°06′40″N, 108°58′59″E, 22 Nov. 2014, *A. Naiki, H.Toyama, S. Tagane, V. S. Dang, H. Nagamasu & H. Tran V2357* [fr.] (FU).

Distribution. Vietnam (currently known only from Mt. Hon Ba).

Habitat and Ecology. *Tarenna aurantiaca* is locally common in broad-leaved evergreen forests from 600–900 m in Hon Ba Nature Reserve. It grows with *Gironniera subaequalis* Planch., *Xerospermum noronhianum* Blume, *Archidendron chevalieri* (Kosterm.) I. C. Nielsen, *Barringtonia pauciflora* King, *Cinnamomum* sp., *Gnetum latifolium* Blume, *Ixonanthes reticulata* Jack, *Triadica cochinchinensis* Lour., *Schima crenata* Korth., *Chrysophyllum roxburghii* G. Don, *Carallia brachiata* (Lour.) Merr. and *He-*

miscolopia trimera Slooten. Flowering specimens were collected in July and fruiting ones in July (immature), February and March (mature).

GenBank accession No. S. Tagane, H. Kanemitsu & V. S. Dang V1681: LC010821 (*rbcL*), LC010822 (*matK*).

Tarenna costata (Miq.) Merr., Philipp. J. Sci. 17: 472 (1921); K. M. Wong, Tr. Fl. Malaya. 4: 415 (1989); Kesonbua & Chantar., Thai For. Bull. (Bot.) 36: 26 (2008). —Figs. 3A–E.

Stylocoryna costata Miq., Fl. Ned. Ind. 2: 203 (1857).
Webera costata (Miq.) Hook. f., Fl. Brit. India 3: 103 (1880).
Typus. Malaysia, Malacca, 14 March 1967, *Maingay 945* (lectotype K!).

Description. Trees, to 8 m tall; young twigs greenish, soon brownish, densely hairy with short, appressed hairs, 4-angled; old twigs reddish brown or greyish brown, hairy or glabrous, subterete or slightly 4-angled. *Stipules* connate near base, triangular to triangular-ovate, 3–5 × 3–4.5 mm, with short acuminate cusp, abaxially pubescent with short appressed hairs, adaxially sparsely hairy with longer appressed hairs. *Leaves* opposite; petiole 1.3–2.7 cm long, pubescent with short appressed hairs; blade obovate to obovate-elliptic, (5.7–)11.5–18.5 × (2.6–)4.7–9.7 cm, base cuneate, margin entire, slightly recurved when dry, apex acute, acuminate, or rarely obtuse, thinly coriaceous, dull, dark green or greyish green when fresh, adaxially dark reddish brown when dry, abaxially dull yellowish green when fresh, dark yellowish pale brown, both surfaces sparsely strigillose, slightly more so on veins, midrib sunken on upper surface, prominent on lower surface, secondary veins 9–16 pairs, ascending at angle of 45–60° from midrib, slightly sunken on upper surface, prominent on lower surface, tertiary veins scalariform-reticulate, inconspicuous on upper surface, conspicuous below. *Inflorescences* terminal, compound corymbiform panicles, subsessile or peduncle to 5 mm long, axis 3–5 branched, 4.7–5.5 × 5.5–9.5 cm, central first order axes 2.3–3.5 cm long, lateral first order axes 1.7–3.0 cm long, 50–110 flowered; bracts linear, 3–6 mm long; pedicels 1.5–2.5 mm long when flowering, elongating to 4.5 mm long in fruit, densely hairy with short appressed hairs; bracteoles 1 or 2, narrowly triangular to linear, 0.7–0.9 mm long, margin densely pubescent. *Flowers* 5-merous. *Calyx* densely pubescent outside, tube 1.6 mm long, ca. 1 mm in diam., lobes 5, broadly triangular, ca. 0.3 mm long, sparsely hairy outside, densely so at margin. *Corolla* pale yellow, tube cylindrical, widening slightly toward throat, ca. 7 mm long, densely hairy with short brown hairs except near base, lobes tongue-shaped, ca. 4 × 1.3 mm, drying black, glabrescent adaxially, pubescent abaxially, stamens 5, alternate corolla lobes, attached to throat; filaments 1.2–1.5 mm long, glabrous; anthers linear, ca. 4 mm long, pale yellow, glabrous. *Ovary* 2-locular, glabrous inside, disc inconspicuous; style exserted 9–10 mm long beyond corolla throat, exserted part and near base glabrous, inserted part silky hairy; ovules ca. 18 in each locule. *Fruits* globose, 4–5.5 mm in diam., sparsely hairy. Seeds 18–28, angular, ca. 1.5 mm in diam., yellowish brown.

Specimens examined. Cambodia — **Kampot Prov.:** Bokor National Park, alt. 721 m, 10°37′40″N, 104°05′35″E, 12 Dec. 2012, *H. Toyama, S. Tagane, T. Ide, P. Chhang, H. Nagamasu & T. Yahara 2099* (Cam, FU); alt. 330 m, 10°36′27″N, 104°04′57″E, 12 Dec. 2013, *S. Tagane, H. Toyama, H. Kanemitsu, M. Zhang & W. Kim 6394* (Cam, FU); alt. 266 m, 10°36′07″N, 104°05′24″E, 15 May 2013, *H. Toyama, S. Tagane, T. Mishima, K. Tagawa, M. Zang, P. Chhang, F. Iwanaga, H. Nagamasu & T. Yahara 3282* (Cam, FU). **Koh Kong Prov.:** Central Cardamon, alt. 425 m, 11°41′52″N, 103°26′16″E, 18 Apr. 2011, *H. Toyama, S. Tagane, P. Chhang & T. Yahara 566* (Cam, FU); alt. 470 m, 11°44′58.87″N, 103°29′17.82″, 21 Apr. 2011, *H. Toyama, S. Tagane, P. Chhang & T. Yahara 787* [fl.] (Cam, FU); in permanent sample plot, tree no. KK05-63, DBH 7.5 cm, alt. 135 m, 11°31′17″N, 103°09′37″E, 19 May 2012, *H. Toyama, S. Tagane, T. Kajisa, R. Tsujino, K. Shinozuka, T. Mishima, M.Zang, P. Chhang & F. Iwanaga 3673* (Cam, FU); in permanent sample plot, tree no. KK02-62, DBH 8.5 cm, alt. 90 m, 11°29′56″N, 103°09′31″E, 20 May 2012, *H. Toyama, S. Tagane, T. Kajisa, R. Tsujino, K. Shinozuka, T. Mishima, M. Zang, P. Chhang & F. Iwanaga 3680* (Cam, FU); edge of evergreen forest, roadside, alt. 146 m, 11°31′20″N, 103°09′26″E, 5 Dec. 2012, *H. Toyama, S. Tagane, K.*

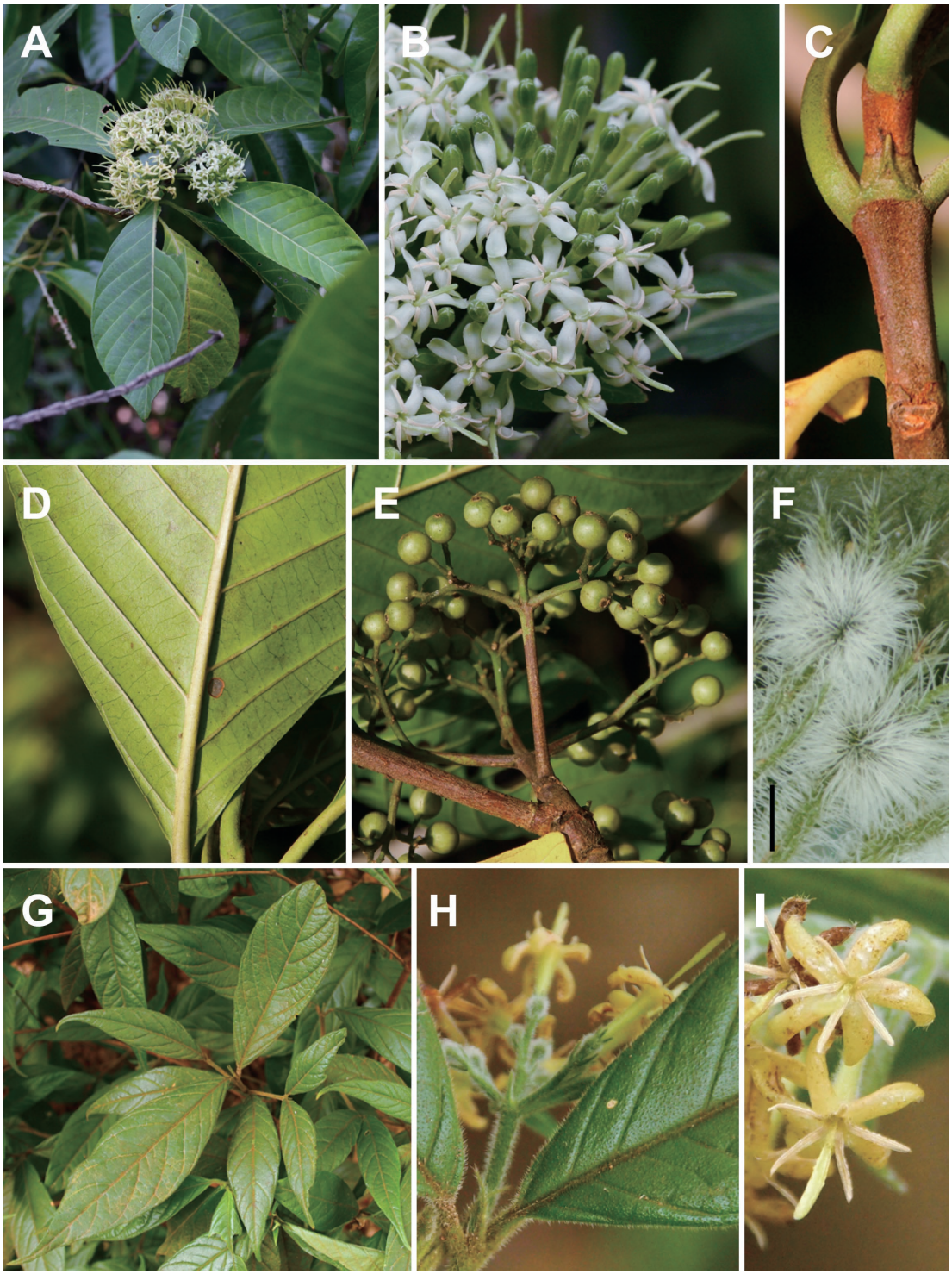

FIG. 3. *Tarenna costata* (Miq.) Merr. A. flowering branch; B. flowers; C. twig with stipule; D. abaxial leaf surface; E. fruits. *Tarenna pilosa* (Craib) Bremk. var. *parvifolia* Naiki & Tagane. F. calyx and pedicel, scale bar = 1 mm; G. sterile branch; H. flowering branch; I. flowers. Specimens: A & B. *Toyama et al. 787* (FU); C–E. *Toyama et al. 5366* (FU); F–I *Toyama et al., 1697* (FU).

Fuse, T. Kajisa, N. Wachi, K. Tagawa, T. Kanao & P. Chhang 4664 [fr.] (Cam, FU); in permanent sample plot, plot tree no. KK14-71, alt., 183 m, 11°32′10.21″N, 103°09′46.85″E, 7 Dec. 2012, *H. Toyama, S. Tagane, K. Fuse, T. Kajisa, N. Wachi, K. Tagawa, T. Kanao & P. Chhang 4712* (Cam, FU); in permanent sample plot, tree no. KK05-63, alt. 137 m, 11°31′17″N, 103°09′37″E, 12 Feb. 2013, *H. Toyama, N. Wachi, S. Tagane, R. Ichihashi, K. Mase, M. Zhu & P.Chhang 5341* (Cam, FU); in permanent sample plot, alt. 135 m 11°31′17″N, 103°09′37″E, 12 Feb. 2013, *H. Toyama, N. Wachi, S. Tagane, R. Ichihashi, K. Mase, M. Zhu & P. Chhang 5366* [fr.] (Cam, FU, K, KYO).

Distribution. Cambodia (first report), India, Indonesia (Sumatra), Malaysia, Philippines, Singapore, Thailand (southeast, peninsular).

Habitat and Ecology. Tarenna costata occurs in wet lowland evergreen forests in the Cardamon and Elephant mountains. The flowering specimens were collected in April, the fruiting specimens in December and February.

GenBank accession No. H. Toyama, S. Tagane, K. Fuse, T. Kajisa, N. Wachi, K. Tagawa, T. Kanao & P. Chhang 4712: LC010819 (*rbcL*), LC010820 (*matK*).

Note. Tarenna costata is an occasional small tree in Bokor National Park and is common in Koh Kong. It has a tree-like habit and hairy obovate leaves with conspicuous lateral nerves (Kesonbua & Chantaranothai 2008).

Tarenna pilosa (Craib) Bremek. var. **parvifolia** Naiki & Tagane, **var. nov.** —Figs. 3F–I.

Tarenna pilosa var. *parvifolia* differs from *T. pilosa* var. *pilosa* in having smaller and narrower leaves with fewer lateral nerves, and erect inflorescences.

Typus. Cambodia. Kampot Province: Bokor National Park, alt. 314 m, 10°36′20.35″N, 104°05′02.07″E, 7 Dec. 2011, *H. Toyama, S. Tagane, T. Kajisa, K. Sakata, M. Nobayashi, N. Mihara, T. Ide, P. Chhang & H. Nagamasu 1697* [fl.] (holo– KYO!, iso–Cam!, FU!)

Description. Shrubs, 1 m tall; younger twigs greenish, densely pilose, terete; older twigs pilose or glabrous, terete. *Stipules* triangular or triangular-ovate, 4–8 × 2–4 mm, apex acuminate, abaxially pilose, adaxially glabrous. *Leaves* opposite; petiole 5–8 mm long, densely pilose; blade narrowly elliptic or lanceolate, 9.5–14 × 2–4.5 cm, base cuneate, apex acute or acuminate, chartaceous, both surfaces pilose, the hairs brownish, especially denser and longer on midrib and at margins of leaf lamina; adaxial midrib and secondary veins depressed, abaxially prominent, secondary veins 8–11 pairs, ascending at angle of 45–50° from midrib. *Peduncle* 1–1.2 cm long. *Inflorescence* terminal, corymbiform panicles, 2.5–4 long × 2–4 cm in diam., axis 3-branched, lateral axes 1–3 mm long, 9–11-flowered; bracts linear to linear-lanceolate 1–1.5 cm long; pedicels 1–2 mm long, with a bracteole in middle. *Calyx* densely pilose with white spreading hairs; tube ellipsoid to globose, 1–1.5 mm long, 0.8–1.5 mm in diam.; lobes 5, narrowly triangular 0.8–1.2 mm long, apex acute. *Corolla* yellowish orange; tube cylindrical, widening slightly toward throat, 7–10 mm long, outside pubescent except near base, inside sparsely pubescent on upper half, glabrous on lower half; lobes 5, oblong 4–5.5 mm long, 2–2.5 mm wide, slightly reflexed in life, glabrous adaxially, pilose abaxially; stamen 5, alternate corolla lobes; filaments ca. 0.5 mm long; anthers linear, 5.5–7 mm long, apex apiculate. *Styles* clavate, 13–17 mm long, exerted 6–10 mm long beyond corolla throat, upper part 6–9 mm from tip, near base glabrous, other parts sparsely pilose with silk-like hairs. *Ovary* 2-locular; ovules 3 in each locule. *Fruit* not seen.

Distribution. Cambodia (endemic).

Habitat and Ecology. Tarenna pilosa var. *parvifolia* occurs at the edge of evergreen forests at middle elevations of Mt. Bokor. Anthesis is in December.

GenBank accession No. H. Toyama, S. Tagane, T. Kajisa, K. Sakata, M. Nobayashi, N. Mihara, T. Ide, P. Chhang & H. Nagamasu 1697: LC010817 (*rbcL*), LC010818 (*matK*).

Another specimen examined. Cambodia—**Koh Kong Province:** 11°33′27.95″N, 103°10′39.84″E, alt. 236 m, 17 May 2012, *H. Toyama, S. Tagane, T. Kajisa, R. Tsujino, K. Shinozuka, T. Mishima, K. Tagawa, M. Zang, P. Chhang,*

F. Iwanaga, H. Nagamasu & T. Yahara 3422 (Cam, FU)

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Key to the species of *Tarenna* in Cambodia, Laos, and Vietnam
[partly based on Pitard (1924), Kesonbua & Chantaranothai (2008) and Chen & Taylor (2011)]

1a. Lower leaf surface glabrous (except for hairy domatia in nerve axils) 2
1b. Lower leaf surface hairy 18
2a. Lateral nerves to 7 pairs 3
2b. Lateral nerves more than 7 pairs 5
3a. Leaf apex acute; flowers sessile ..... *T. tonkinensis* Pit.
3b. Leaf apex acuminate, cuspidate or caudate; flowers pedicellate, pedicel up to 3 mm long 4
4a. Leaf blade 6–10 cm long; petiole 6–12 mm long; ovule 1 per locule ..... *T. attenuata* (Hook. f.) Hutch.
4b. Leaf blade 10–14 cm long; petiole 12–18 mm long; ovules 4 per locule ..... *T. bonii* Pit.
5a. Inflorescence capitate ..... *T. capitata* Pit.
5b. Inflorescence corymbose 6
6a. Axes of inflorescence glabrous 7
6b. Axes of inflorescence pubescent or puberulent 9
7a. Flower sessile; calyx lobes fused into a cylindrical tube 2.5 mm long ..... *T. hoaensis* Pit.
7b. Flowers pedicellate; calyx lobes triangular, apex acute 8
8a. Corolla tube shorter than corolla lobes ..... *T. citrina* Pit.
8b. Corolla tube longer than corolla lobes ..... *T. thorelii* Pit.
9a. Leaves chartaceous 10
9b. Leaves coriaceous 13
10a. Leaf blade elliptic ..... *T. collinsae* Craib
10b. Leaf blade oblong, obovate or lanceolate 11
11a. Inflorescences 8–18 cm long ..... *T. latifolia* Pit.
11b. Inflorescences 1–8 cm long 12
12a. Inflorescences to 2 cm long; calyx lobes fused into a cylindrical tube ..... *T. membranacea* Pit.
12b. Inflorescences 2–8 cm long; calyx lobes triangular, apex acute ..... *T. vanprukii* Craib
13a. Ovule 1 per locule 14
13b. Ovules 2 or 3 per locule 16
14a. Calyx tube and lobes glabrous ..... *T. annamensis* Pit.
14b. Calyx tube and lobes pubescent 15
15a. Fruits more than 7.5 mm in diam.; persistent calyx lobes narrowly triangular ..... *T. quocensis* Pit.
15b. Fruits less than 7.5 mm in diam.; persistent calyx lobes broadly triangular ..... *T. wallichii* (Hook.f.) Ridl.
16a. Leaf blade elliptic; pedicel 2–3 mm long; ovules 2 per locule ..... *T. disperma* (Hook.f.) Pit.
16b. Leaf blade oblong-lanceolate; pedicel 1–2 mm long; ovules 3 per locule ..... *T. asiatica* (L.) Kuntze ex K.Schum.
17a. Upper leaf surface glabrous 18
17b. Upper leaf surface hairy 19
18a. Leaves coriaceous; flower sessile pedicel; ovules 4 per locule ..... *T. harmandiana* Pit.
18b. Leaves chartaceous; flowers pedicellate, ovules 15–20 per locule 19
19a. Corolla white, corolla tube 3–4 mm long ..... *T. mollissima* (Hook. & Am.) B. L. Rob.
19b. Corolla orange, corolla tube 9–11 mm long, ... ***T. aurantiaca* Naiki & Tagane**
20a. Petiole more than 10 cm long; pedicel more than 3 mm long 21
20b. Petiole less than 8 cm long; pedicel less than 2.5 mm long 22
21a. Leaf blade 20–27 cm long, apex acuminate or cuspidate, lateral nerves 9–11 pairs ..... *T. baviensis* (Drake) Pit.
21b. Leaf blade 12–22 cm long, apex obtuse, lateral nerves 8–9 pairs ..... *T. chevalieri* Pit.
22a. Leaf blade obovate to obovate-elliptic, more than 4.5 cm wide ..... *T. costata* (Miq.) Merr.
22b. Leaf blade narrowly elliptic or lanceolate, to 4.5 cm wide ..... ***T. pilosa* (Craib) Bremek. var. *parvifolia* Naiki & Tagane**

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